FOREST PRODUCTS
Project Fact Sheet

CONTROL OF GROWTH EFFICIENCY IN YOUNG PLANTATION LOBLOLLY PINE AND SWEETGUM THROUGH IRRIGATION AND FERTIGATION ENHANCEMENT OF LEAF CARBON GAIN

BENEFITS

- Increase understanding of the physiological mechanisms in trees that respond to water and nutrients
- Allow foresters to manipulate these resources for optimal wood and fiber production
- Quantitatively measure gains in biomass following water and nutrient augmentation
- Refine science of forestry management by correlating resource augmentation with maximum tree growth

APPLICATIONS

Forest managers can use the knowledge gained in this study to directly influence the productivity of their stands.

Growth Efficiency in Tree Plantations May Be Significantly Boosted by Fertigation

A better understanding of the physiology and biochemistry of trees will help enhance the productivity of commercially managed forests. In the southeastern United States, water and nutrients are limited and the leaf area and photosynthetic efficiency in pine and hardwood stands are perhaps 50 percent below their potential for biomass production. Investigations have shown that this decline begins about the third year after a plantation is established, but if water and nutrients are provided artificially, significant improvements in the production of wood and fiber will be observed. Augmented stands also show a more complex canopy structure and tend to be more self-shading.

There is some indication that water and nutrients improve carbon gain in leaves by reducing leaf sensitivity to high temperatures and water-pressure deficits. Leaf photosynthetic efficiency, leaf area production, and carbon allocations are among the proposed mechanisms responsible for enhanced stem growth in the presence of adequate water and nutrients. Once the important physiological mechanisms of tree growth are known, forestry managers will be able to manage the amount of carbon gain by controlling the use of these resources.

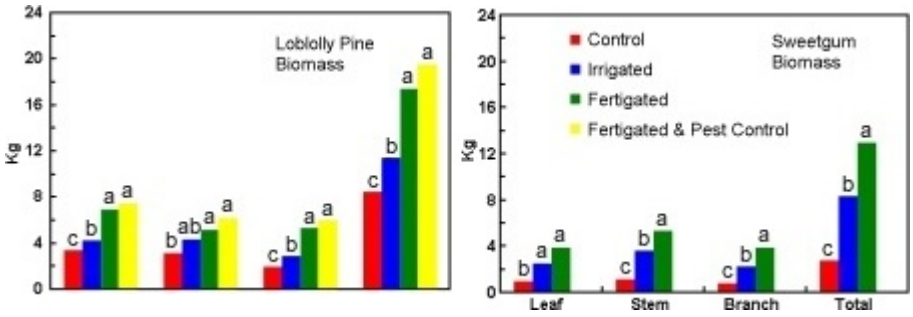

Figure 1. Influence of intensive culture on aboveground biomass on 3-yr-old sweetgum and loblolly pine.

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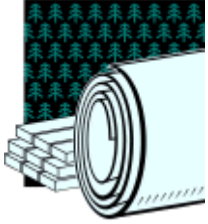
PROJECT DESCRIPTION

Goal: To determine if fertigation maintains or improves growth efficiency, and if leaf carbon gain is the mechanism for this response; to clarify the physiological mechanisms that respond to enhanced water and nutrient resources, leading to improved leaf carbon gain; and to improve basic knowledge of tree physiology and the mechanisms that control forest productivity.

Researchers will conduct a two-year investigation to test several hypotheses. They have proposed that a lack of water and nutrients is more limiting to tree growth than poor light, and that fertigation improves carbon gain in leaves in both shaded and sunny locations by increasing stomatal and mesophyll conductance, light-use efficiency, and the ability of leaves to maximize photosynthesis at high temperature and vapor-pressure deficit. Moreover, they suggest that trees that undergo fertigation will not begin to grow less efficiently three years after a stand is planted.

PROGRESS & MILESTONES

- This effort will take place at a 15-ha study site maintained by International Paper in Georgia.
- Measurements of leaf carbon gain will be taken three times during each of two growing seasons on three-year-old loblolly pine and sweetgum stands.
- The stands will be managed in one of four ways: (1) weed control only; (2) weed control and irrigation; (3) weed control, irrigation, and fertigation; or (4) weed control, irrigation, fertigation, and pest control (pine only).
- Stem growth will be monitored during the growing seasons, with a selection of trees harvested each season to measure the increment in above-ground woody biomass, leaf mass, and leaf area.



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